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The perception of climate change: Comparative evidence from the small-island societies of Bougainville and Palawan

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ABSTRACT

In this study we investigate and compare factors that influence local people's perception of climate change and understanding of its causes in the coastal small island societies of Bougainville (Papua New Guinea) and Palawan (Philippines). According to the Intergovernmental Panel on Climate Change (IPCC) small island societies are among the most vulnerable to climate change. However, the majority of the existing studies focus on Australia, the United States and Europe and few carry out cross-country comparisons to find general trends or cross-national differences. Based on a quantitative analysis our empirical research suggests that factors such as education, access to information via mobile phones and radios and market integration increase people's awareness of climate change independent of their cultural background. At the same time, these factors do not seem to affect people's understanding of the causes of climate change, while subjective vulnerability partly does. Misperception of climate change causes is quite heterogeneous suggesting that local factors such as beliefs, values, and other short-term pressing problems (such as poverty and food security) limit understanding. The results of the present paper provide valuable insights for the design of climate policies at national as well as the local level.

1. Introduction

According to the IPCC small island societies are among the most vulnerable to climate change (Nurse et al., 2014). A large number of studies provide scientific evidence that the frequency and severity of storms is increasing and that the sea-level changes in connection with climate change. Thus, climate change becomes a vast challenge for small island societies and requires immediate action to develop adaptation strategies. Yet, adaptation is not only a technical challenge. Public perception of climate change and public understanding of the causes, the associated risks and dangers of climate change greatly influence public support of climate change policies (e.g., Leiserowitz, 2006; Lorenzoni et al., 2007; Moser, 2010; Nisbet, 2009; Pidgeon, 2012).

A large literature exists that analyzes the public perception of climate change. The regional coverage of such studies varies significantly. Most of the studies focus on Australia, the United States and Europe (e.g., Brulle et al., 2012; Lorenzoni and Pidgeon, 2006; Whitmarsh, 2011) and few carry out cross-country comparisons to find general trends or cross-national differences. Exceptions are the studies by Kvaløy et al. (2012) and more recently Lee et al. (2015). Lee et al. (2015) carried out a cross-sectional survey across 119 countries, probably the most extensive of all such studies to-date.

Despite this large country coverage, small island societies are underrepresented. Only a few studies have investigated how people in Pacific small island states perceive and how much they are aware of climate change in general (e.g., Kuruppu and Liverman, 2011; Kuruppu and Willie, 2015; Lata and Nunn, 2012; Lebel, 2013; Aswani et al., 2015; Scott-Parker et al., 2017). Previous studies conducted in small island societies find that people have limited understanding of climate change (e.g., Scott-Parker et al., 2017;

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Scott-Parker and Kumar 2018) or may be completely unfamiliar with it (Lata and Nunn, 2012; Nunn et al., 2014; Mataki et al., 2007). Further, studies have shown that islanders who have knowledge about climate change are unsure about the reasons (e.g., Dumaru, 2010; Lata and Nunn, 2012). Betzold (2015) notes that comparative studies – comparisons across different islands – are largely missing in this literature (see also McMillen et al., 2014; Kelman, 2010; Nurse et al., 2014). Only a limited number of cross-cultural and cross-country studies exist that analyze public understanding of climate change (e.g., Beyerl et al., 2018; Rawlins et al., 2007). If indeed the understanding of climate change is limited in these societies and causes are not well understood across societies it would be important to identify the determining factors. Adaptation measures are successful if people are aware of climate change and understand the causes of it.[1]

In the present study we investigate and compare factors that influence local people's perception of climate change and understanding of its causes in two coastal small island societies, Bougainville (Papua New Guinea) and Palawan (Philippines). These economically less developed communities are among those small island societies that will be particularly vulnerable to climate change and which face greater risks of experiencing extreme events (Hay and Mimura, 2006; Nurse et al., 2014). So far, most cross-cultural studies use descriptive statistics to analyze data from semi-structured interviews. We complement previous research by using statistical procedures (mainly econometrics) to identify the magnitude and significance of factors influencing climate change awareness and understanding of its causes based on survey data. The present study aims to provide valuable insights for the design of climate policies at the national as well as the local level.

1.1. Previous work

Previous studies have identified a number of factors – including experiential, physical, psychological and socio-cultural factors – that influence climate change awareness (see Baptiste, 2018; Borick and Rabe, 2010; Hine et al., 2016; Nunn et al., 2016a,b; Weber and Stern, 2011; Wolf and Moser, 2011). Among these, education is the most important predictor of climate change awareness. For small island societies there is so far no comparative empirical evidence if education increases climate change awareness and if it leads to greater in-depth knowledge on the causes of climate change (Scott-Parker et al., 2017; Scott-Parker and Kumar 2018).

Another important factor that may influence climate change awareness is the access to information. Besides traditional ways of communication (i.e., talking with family members, friends and neighbors), studies have found that television, radio and newspapers are important sources of climate change information in small island societies (e.g., Baptiste, 2018; Lata and Nunn, 2012). Recently, communication devices (e.g., mobile phones) that provide access to the internet play an important role for economic development in rural areas and may be relevant to spread information about climate change among island communities. In their cross-country study, excluding small island societies, Lee et al. (2015) found evidence that awareness is greater for those with better communication access. In this study we hypothesize that mobile phones and radios are important predictors of climate change awareness in both societies.

Connectivity to markets is another factor which has been neglected by the literature on climate change perception in small island societies so far. Bunce et al. (2009:223) found that cross-scale connectivity (which implies an intertwining of the flow of people, goods, information, money as well as power as defined by Newton and Weichselgartner, 2014:126) is a critical component of social and ecological resilience in remote small island societies (see also Bayliss-Smith et al., 2006; Bertram, 2004; Janssen et al., 2006a,b, 2007). An islander's engagement in market exchanges increases his or her connectivity to others and leads to knowledge transfers that are not limited to the local level. Thus, connectivity to markets may increase awareness about climate change.

Finally, previous studies conducted in the United States found evidence that physical vulnerability – place and proximity to climate change risks – influences risk perceptions (see e.g., Brody et al., 2008; Lindell and Hwang, 2008; Peacock et al., 2005). Other studies focused on objective indicators such as key socioeconomic variables and other types of capital that support people's livelihoods (Bahadur et al., 2015). Measuring subjective vulnerability addresses some factors that are neglected by previous studies such as cultural specifics and local people's own knowledge of their resilience. An individual's self-assessed perception of vulnerability might be important as well: more vulnerable people might be more aware of climate change and its origins. We test the significance of these factors on climate change awareness and its causes.

The remaining parts of this study are structured as follows: Section 1 briefly describes the two study areas. Section 3 outlines the survey design (3.1) and data analysis (3.2). Section 4 includes the results of the empirical analysis. Section 5 provides a discussion and Section 6 ultimately concludes.

2. The study areas

We conduct our study in two island societies where culture and its influence on the social order of a society play a more prominent role. The two study sites share similar geographic characteristics, environmental and development challenges, but differ in important cultural attributes. We can therefore exclude the possibility that differences in the geo-ecological conditions or other important dimensions drive differences in our data. This setting is an important improvement to previous studies that explore local people's perception of climate change and understanding of its causes across different societies. The data of the present study comes from the Palawan in the Philippines (PHI) and the Teop from Bougainville Island in Papua New Guinea (PNG). Fig. 1 displays a map of the

[1] Empirical research showed that climate change awareness and understanding of causes are important factors of successful adaptation (e.g., Kibue et al., 2016; Marshall et al., 2013; Vignola et al., 2010).

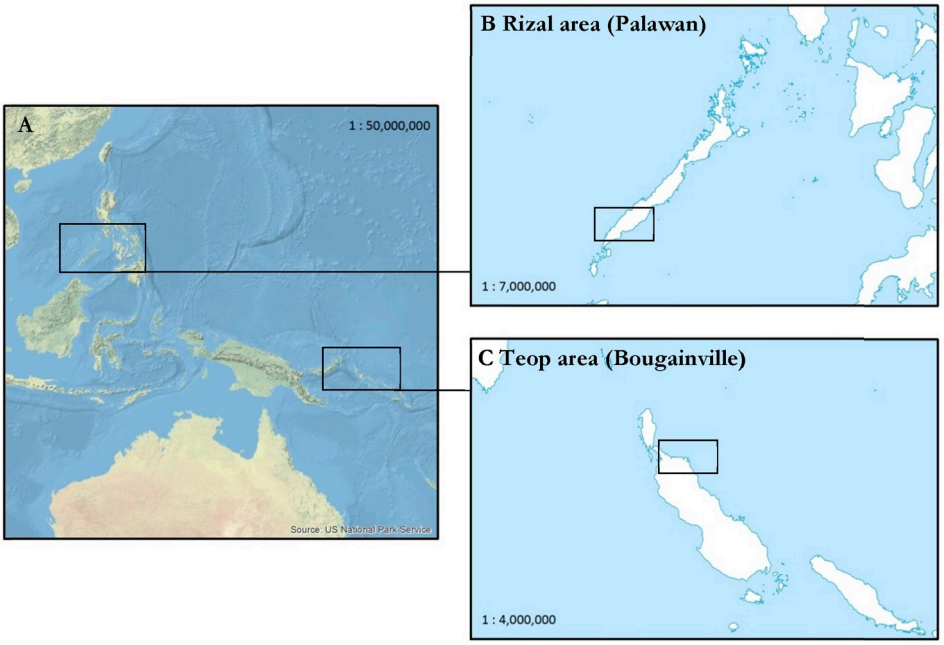

Fig. 1. Map A: Palawan (left) and Bougainville (right); Map B: Rizal area in the south of Palawan Island (latitude: N 8° 50′ 1.933″ and longitude: E 117° 35′ 47.545"; WGS 84); Map C: Teop area in the north-eastern part of Bougainville Island (latitude: S 5° 34′ 22″ and longitude E 155° 4′ 44.00"; WGS 84); *Source*: OpenStreetMap and contributors (CC by SA) and U.S. National Park Service.

islands and the area where the research was undertaken.

Both societies differ substantially in terms of culture and history, but they share certain development challenges (e.g., Briguglio, 1995). Besides smallness these include also a remote spatial location and being vulnerable to natural disasters such as tsunamis, storms, floods, coastal erosion (Betzold, 2015). Further, they also face commonly known environmental challenges including coastal erosion, loss of biodiversity, soil loss, water shortage, and solid waste pollution (e.g. Barnett, 2011; Betzold, 2015; Connell, 2013). These types of challenges are intensified by climate change. As typical for island societies in this region, it is the current and future impacts of climate change and associated emerging coastal processes that are threatening the communities. Among respective issues are changing precipitation and storm patterns as well as other crucial climate-related stressors such as groundwater salinization, the erosion of shorelines and issues of food security (Barnett and Campbell, 2010; Hay et al., 2003; Lata and Nunn, 2012; Nunn et al., 2007). In combination with low capacities for adaptation and little economic development opportunities this makes these two island societies particularly vulnerable.[2]

In both societies, formal institutions that maintain the enforcement of legal rules are hardly present. This means that social life is regulated almost completely by social norms (Bernhard et al., 2006:912). Social structure is organized around tribes and clans, and social norms are guarded by village chiefs and clan or religious leaders. These leading people gather a large group of followers around them: within their clan, across related groups, and among different villages (see Grimalda et al., 2016; Pondorfer et al., 2016; Pondorfer and Rehdanz, 2018). As a result, decision-making processes affecting the community (e.g. implementation of adaptation measures) have to be arranged by the bottom-up approach. This form of decision-making process is in the studied areas widely accepted and has provided communities with stability and sustainability (Lata and Nunn, 2012). At the same time, this approach towards decision-making is not immune against the challenges of a modern and more globalized world including population pressure due to rapid growth, development and health challenges, decline of resources and the impacts of climate change (Aalbersberg, 2005; Lata and Nunn, 2012:182, Nunn, 2009).

The indigenous Palawan form an ethnic group that live in the Palawan archipelago. Our respondents were located in small coastal villages in the southern part of Palawan island in an area called Rizal (see Pondorfer et al., 2016:3). The majority of people lives in traditional houses and has no access to electricity. People livelihood mainly depends on farming and fishing (Alcantara and Barnett, 1994; Limsa, 2014).

The Teop in Bougainville are a unique language group and can be characterized as an island society that identifies to be of matrilineal and matrilocal nature (see Grimalda et al., 2016, Pondorfer et al., 2016:3, and Pondorfer and Rehdanz, 2018:76–77). Our

[2] The Intergovernmental Panel on Climate Change (IPCC) defines adaptive capacity as follows: “Adaptation to climate change and risks takes place in a dynamic social, economic, technological, biophysical, and political context that varies over time, location, and sector. This complex mix of conditions determines the capacity of systems to adapt” (IPCC, 2001:895). Small island societies face many challenges in this context, and thus, have usually low capacities for adaptation.

Table 1
Survey questions.

Variable	Survey question	Response categories
A. Socio-economic and demographic characteristics and connectivity		
Gender		(1) Male; (2) Female
Age	In which year were you born?	
Level of education	What is your highest completed level of education?	(1) No school; (2) Elementary (incomplete); (3) Elementary (complete); (4) Highschool (incomplete); (5) Highschool (complete); (6) Tertiary (college/university); (7) Other (Specify!)
Occupation	What is your main activity in terms of work?	(1) Work on household garden/production; (2) Fishing; (3) Wage labour (employed by somebody); (4) Health worker; (5) Handcraft/ Artisan; (6) Teacher; (7) Student; (8) Civil servant; (9) Church worker; (10) Does not work; (11) Other (Specify!)
Capital visits	How often do you go to the island capital?	(1) Never; (2) Once a year; (3) Several times in a year; (4) Monthly
Trade activities	How do you usually make some money (income source)?	(1) Sale of home production (selling food from household garden); (2) Trade (not of won goods – only from purchase and re-sale); (3) Rental income (e.g., land, house, machinery, etc.); (4) Cash remittances (getting money from relatives and community members); (5) In kind remittances (getting food or tools from relatives and community members); (6) Wage labor (casual or professional); (7) Other (Specify!)
Connection to electricity	Is the house you living in connected to electricity?	(1) Yes; (2) No
Assets[a]	How many of the following animals or assets does the household you live in own? *(calculate for the whole household)*	Stated number in the following categories: Saw Radio, Chicken, Flashlight/Torch, Pigs, Petroleum lamp, Cattle, Beehive, Carabao (Water buffalo), Boat/canoe, Table(s) that belong to the house, Chair (s) that belong to the house, Generator
Mobile phone	Do you have a mobile phone?	(1) Yes; (2) No
Materials of the house	What is the main material of the walls of your house?	(1) Stone/cement; (2) Wood; (3) Metal; (4) Bush material; (5) Other (Specify!)
B. Perception of climate change		
Awareness of climate change	Have you ever heard or come across information about climate change?	(1) Yes; (2) No; (3) Not sure
Understanding of climate change	What do you think causes climate change?	(1) Pollution from outside the community; (2) God's will; (3) Nature/ Natural processes; (4) Other (specify)
C. Perceived vulnerability with respect to other community members		
Vulnerability	Compared to other members of your community would you say that the impacts (like crop failure or little income) of …. o shortage of rain affect you… o too much rain affect you… o crop disease, pest, insects affect you… o sea level rise (coastline gets under water) affect you …	(1) More; (2) About the same; (3) Less

[a] Note that question about assets slightly differed between Palawan and Bougainville. Behive and carabo (water buffalo) are common livestock in Palawan but not in Bougainville. Thus, we did not include beehive and carabo (water buffalo) in the Bougainville survey.

respondents were again located in small settlements near the coast in the North-East of the main island. Teop people also live in traditional houses with no access to electricity. The economic mainstay of the Teop comes from farming. In addition, this subsistence pattern is complemented by fishing, hunting and foraging activities (Regan and Griffin, 2005).

3. Methodology and data

3.1. Survey design and sampling

The design of our survey was set up in such a way that we could investigate respondent perception of climate change and its causes in a cross-cultural setting (see Table 1 for all survey questions).

Therefore, we asked respondents first if they have or have not heard about climate change or whether they were unsure.[3] Next, we asked those who stated that they have heard of climate change about its causes. To ascertain the most suitable answer categories for the causes of climate change we relied on focus groups and pre-tests.[4] Based on the results we restricted the item categories for the

[3] Following previous studies conducted in small island societies (Lata and Nunn, 2012; Dumaru, 2010), we asked respondents for the keyword *climate change* without giving a further definition of the term. We discuss challenges associated with the translation of climate change and what is understood to be its cause or consequence in Section 5. Also note that we chose a dichotomous format for the awareness variable in order to be able to do a more comprehensive comparison of our results to the previous literature (e.g., Lata and Nunn, 2012).

[4] We organized focus group discussions with a small number of people in each study site. The content of the focus groups was limited to climate change and its causes as well as potential vulnerabilities. Participants were asked to identify what they perceive as the primary causes of climate

causes of climate change to the following three: divinity, nature and pollution. This is in line with previous literature. Lata and Nunn (2012), for example, use the same set of items with respondents from the Rewa Delta (Fiji), a similarly remote region.

For the investigation of factors that may influence the awareness of climate change and its causes among the study groups we collected additional data in the following three domains of a respondent: (i) socio-economic and demographic characteristics, (ii) connectivity to markets and media, and (iii) perceived vulnerability compared to other community members.

Besides general demographic characteristics such as gender, age and education, the questionnaire sought information on wealth. To allow for a comparison of wealth between the two societies we considered a total of seven assets. These are of comparable value and also of comparable use across the two societies. The items include: saws, boats, torch, lamp, chairs, tables and generators. We computed a wealth index which is defined as the sum of positive responses over the seven asset categories. The wealth index takes on values ranging from 0 to 7; low (high) index numbers indicate low (high) wealth levels. The wealth index is a proxy for income and was used by previous field studies in Papua New Guinea and the Philippines (e.g., Grimalda et al., 2016; Pondorfer et al., 2016; Tracer et al., 2004).

To analyze the degree of a respondent's connectivity, we computed two variables. The first connectivity variable - called market integration - is an index which is based on information about people's integration to markets (i.e., wage labor, trade activities, capital visits and a household's availability of electricity via generators). Previous studies conducted in Papua New Guinea used market integration to investigate the relationship between “market norms” and pro-social preferences (e.g., Henrich et al., 2010). Wage labor and trade activities directly reflect a respondent's market integration. The main reasons for visits to the island capital are financial matters and the purchase of commodities that are not available in the villages. The availability of electricity is a proxy for the possession of goods that are exclusively available on markets (e.g., generator, petrol, radios, mobile phones, lightbulbs etc.). The market integration index is defined as the sum of positive responses over the four categories and takes on values ranging from 0 to 4; low (high) index numbers indicate low (high) levels of integration.[5] The second connectivity variable - called access to information - is a dummy variable that measures if a respondent has access to information (i.e., radio and mobile phone) or not. This dummy variable takes on the value 1 if a respondent owns either a radio or a mobile phone (or both) and 0 if none of these assets are possessed.

A respondent's perceived vulnerability is based on events that the person had experienced and that was perceived as major threat to the livelihood. Based on focus group discussions we considered the following four events: shortage of rain, abundance of rain, crop diseases and sea-level change. To measure vulnerability, we asked all respondents to evaluate the damage of each event on their household relative to those of other villagers. This ordinal comparison approach was implemented via a three-point scale (less, about the same, or more). The vulnerability index is defined as the sum of responses in the last category (higher). The index takes on values ranging from 0 to 4; low (high) index numbers indicate low (high) perceived relative vulnerability.[6]

The survey was conducted between July and October 2013. A total of 94 Palawan people (49 men, 45 women) and 99 Teop people (50 men, 49 women) voluntarily participated in the interviews across multiple villages/settlements. Thus, information from a total of 193 people is analyzed in this study.[7]

With respect to the recruitment of subjects, we follow the procedures of studies conducted in the area (see Pondorfer et al., 2016; Pondorfer and Rehdanz, 2018). The research team entered villages and draw a random sample from a residence list. In some cases these lists were already available, in some other cases we asked local village chiefs to prepare one. Each respondent was given the questionnaire in a face-to-face interview. The interviews were carried out in the local language by local research assistants who again were supervised by the researchers. The interviews took place in a closed-off area (e.g., classroom) without any other person present. To instruct the assistants on how to conduct the interviews, we organized a three-day workshop in the field.

3.2. Data analysis

First, we compare the respondents of the two island societies with respect to their socio-economic and demographic characteristics, market integration, access to information, and perceived vulnerability. Next, we investigate climate change awareness. To test if perceptions of climate change and its causes vary between the two small island societies we present descriptive statistics and the

(*footnote continued*)

change. Moreover, we asked them to identify climate related events that they have experienced and that were a major threat to their livelihood. The latter questions were used to construct items for the perceived vulnerability questions. With the support of local assistants, we made notes during the open discussion which prioritized local opinions and experiences. Subsequently we constructed our survey items and conducted a pre-test of the survey by interviewing a small sample of randomly selected respondents.

[5] Responses to questions related to wage labor, trade activities, and electricity via generator were coded as binary variables which take on the value 1 for positive responses (yes), and 0 for negative responses (no). The measure for capital visits was also transformed into a binary variable taking on the value 1 (several times in a year, monthly) and 0 (never, once a year).

[6] To construct the vulnerability index, we transformed the vulnerability measure into a binary variable taking on the value 0 (less, about the same) and 1 (more vulnerable). The index is based on the sum of the binary variables across the four categories (rain, abundance of rain, crop diseases and sea-level change). For example, an index of 4 indicates that the respondent stated that she feels more vulnerable than others in all four categories; an index of 2 indicates that she feels more vulnerable than others in two out of four categories; an index of 0 indicates that the she feels equally or less vulnerable compared to other community members in all four categories.

[7] Note that we have interviewed a total of 206 people, but we excluded 13 respondents that reported that they are unsure whether they have or have not heard about climate change.

relevant test statistics. All tests of differences in means are conducted using a Wilcoxon rank-sum test. Our results are robust to using a *t*-test or chi-square tests.[8]

To analyze factors that influence respondent awareness of climate change and its causes, we run simple regression models. Due to the dichotomous nature of our dependent variables, we fit logistic linear regression models (logit model). More specifically, we apply a well-established method — namely the Firth logit regression (Firth, 1993) — which is recommended for small samples with a skewed distribution of the dependent variable, and a quasi-separation in the data such as ours (see Coveney, 2015 and Heinze and Schemper, 2002 for further details).

4. Results

4.1. Respondent characteristics

Table 2 presents summary statistics with respect to socio-economic and demographic characteristics, market integration, access to information and perceived vulnerability.

Several observations are noteworthy. First, the average age of respondent (43 years) is about the same across the two societies. Second, respondents from Teop are slightly wealthier than Palawans as measured by the number of household assets (for wealth index: $p = 0.12$). Third, perceived relative vulnerability is higher in the Philippines than in Bougainville ($p < 0.01$). Fourth, access to information and market integration are statistically not distinguishable between the two societies (for access to information, $p = 0.89$; for imarket integration, $p = 0.25$). Fifth, Teop people have a significantly higher educational attainment than Palawan people ($p < 0.05$). Sixth, due to the strong presence of Christian missionaries in Bougainville, all Teop respondents are Christians. In Palawan about 40% of the respondents are Muslims and the remaining fraction mainly Christian (about 50%). Finally, the number of male and female participants is almost identical in both societies.

4.2. Awareness of climate change

Turning to respondent awareness of climate change, Fig. 2 shows the percentages of respondents that have heard about climate change for the Palawan and the Teop respectively as compared to those that have not heard of climate change.

Across societies, Teop people are more aware of climate change than Palawan people. About 89.8% of the Teop people have heard about climate change, compared to 68.3% of the Palawan. This difference is statistically significant ($p < 0.001$).

To find out which factors influence awareness and to explain the difference between Teop and Palawan, we run a simple regression model presented in Table 3. In the first specification we pool the data from Teop and Palawan respondents and provide a sense of data patterns across the two societies. The variable *Society* captures differences between the two societies. It is a dummy variable which takes on the value 1 for the Teop society, and 0 for the Palawan society. Thus, a positive sign of *Society* indicates that Teop people are more aware of climate change than Palawan people, while a negative sign indicates the opposite. In the second and third specification we present regression results by society, permitting the explanatory variables to have heterogeneous effects in each society. All regression models include respondents' gender, basic socio-economic and demographic characteristics (age, education, wealth and religion), individuals' perceived vulnerability and connectivity to markets and media as explanatory variables. Note that the dependent variable *respondent's awareness of climate change* is a dummy variable which takes on the value 1 if respondents have heard about of climate change and 0 if they have not heard about it.

Focusing on the results of the pooled model, the regression results confirm our earlier results based on descriptive statistics; significant differences in awareness exist between the two societies even when we control for other factors. The coefficient of *Society* is positive and statistically significant indicating that Teop people are more aware about climate change than Palawan people. Education, age, access to information and market integration are positive and statistically significant predictors of climate change awareness. In our case, education perfectly predicts climate change awareness for the sub-sample of Teop. The results show that the probability to hear about climate change is increasing with an individual's education level, age and connectivity. In contrast, the coefficient of perceived vulnerability is close to zero and statistically not significant on the aggregated level. The same holds for the other socio-economic and demographic variables like gender, religion and wealth.

On the society level (columns 2 and 3) we confirm that education and market integration are important factors that influence awareness. The coefficients are larger in Teop than in Palawan but the level of significance is also lower. Access to information is statistically significant and of considerable size in Palawan but negative and insignificant in Teop. Moreover, vulnerability (weakly) predicts awareness of climate change in Teop but is negative and statistically not significant in Palawan.

Overall, these results suggest that factors like education and market integration have a positive effect on awareness in both societies but the extent of the effect differs across societies. In contrast, access to information seems to be more society-specific while vulnerability has no effect at all.

[8] We analyzed the data using non-parametric tests (reported) and parametric tests such as *t*-test and chi-squared tests (results are available on request). The Wilcoxon rank-sum test is a non-parametric method to analyze data with skewed distributions. Unlike the *t*-test and chi-square it does not require the assumption of normal distribution. Since the mean differences hold for non-parametric and parametric tests, we assume that our results are not driven by the skewed distribution of the data.

Table 2
Descriptive statistics.

	All respondents	Teop (PNG)	Palawan (PHI)
	mean (s.d.)	mean (s.d.)	mean (s.d.)
Age (years)	43.02	43.29	42.73
	(14.21)	(12.79)	(15.64)
Wealth (index)	4.05	4.30	3.81
	(1.64)	(1.31)	(1.87)
Vulnerability (index)	1.12	0.88	1.38
	(1.01)	(0.96)	(1.01)
Access to information (dummy)	0.61	0.62	0.61
	(0.49)	(0.49)	(0.49)
Market integration (index)	1.08	1.14	1.01
	(0.69)	(0.69)	(0.65)
Education			
Less educated (no school, elementary or primary school)	49.74%	42.42%	57.45%
More educated (highschool, secondary highschool or tertiary education)	50.26%	57.58%	42.55%
Religion			
Muslim	19.69%	0%	40.43%
Non-Muslim	80.31%	100%	59.57%
Gender			
Male	51.30%	50.51%	52.13%
Female	48.70%	49.49%	47.47%
Observations	193	99	94

s.d. = standard deviation.

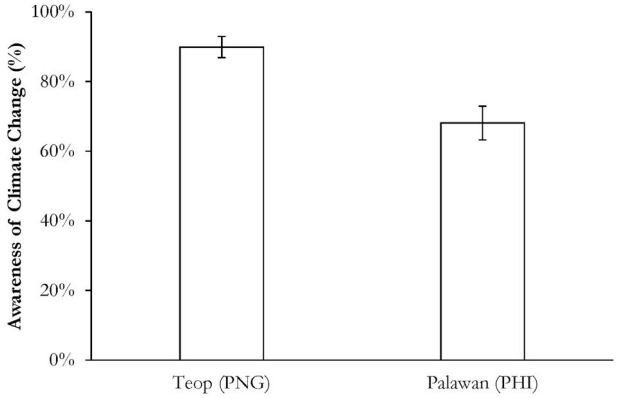

Fig. 2. Fraction of people that heard about climate change (with error bars).

4.3. Perceived causes of climate change

Respondents who have heard about climate change were also asked about its causes. As described above, we restricted response categories to the three most common causes: divinity, nature and pollution. In addition, we offered the answer category 'don't know', but this category was not chosen by any of the respondents. Fig. 3 presents the percentage of answers for the three categories separately for Teop and Palawan.[9]

We find significant differences in reported causes with respect to divinity and nature, respectively. About 13.6% of Teop respondents believe that climate change is the will of god compared to 35.9% of Palawan respondents. In contrast, 42.0% of Teop people think climate change is a natural process compared to 17.2% of Palawan people. These differences are statistically significant (for god's will, $p < 0.001$, for nature, $p < 0.001$). With respect to pollution, reported responses are identical across societies ($p = 1.00$). About 44.3% of Teop and 46.9% of Palawan people state that pollution causes climate change, respectively.

To identify factors that may influence people's opinion about the causes of climate change, we run a regression model using the same specifications as in Table 3 above. Tables 4 A–C present results for the pooled data as well as individually for the two societies for the three dependent variables: divinity (Table 4A), nature (Table 4B) and pollution (Table 4C). Again, the variable *Society*

[9] Note that Fig. 3 is based on 88 (Papua New Guinea) and 64 (Palawan) observations, respectively. The data is based on survey respondents who stated that they have heard about climate change. The Teop sample does not sum up to 89 because we failed to document one observation in the reported causes of climate change.

Table 3
Regression results (dependent variable: awareness).

	(1) Pooled			(2) Teop			(3) Palawan		
	coeff.	std. error	p-value	coeff.	std. error	p-value	coeff.	std. error	p-value
Society (0 = Palawan, 1 = Teop)	**1.40**	**0.55**	**0.01**						
Male (0 = female, 1 = Male)	−0.47	0.43	0.28	−1.00	0.95	0.29	−0.05	0.52	0.92
More educated (0 = less educated, 1 = more educated)	**2.08**	**0.58**	**0.00**	**3.16**	**1.64**	**0.05**	**1.51**	**0.68**	**0.03**
Age	**0.04**	**0.02**	**0.01**	0.03	0.04	0.34	**0.05**	**0.02**	**0.01**
Wealth	−0.13	0.14	0.36	−0.01	0.36	0.98	−0.08	0.16	0.63
Muslim (0 = Non-Muslim, 1 = Muslim)	−0.20	0.53	0.70				−0.23	0.54	0.68
Vulnerability	0.05	0.22	0.82	1.17	0.71	0.10	−0.24	0.27	0.39
Information access	**1.02**	**0.47**	**0.03**	−0.38	0.90	0.67	**1.42**	**0.58**	**0.01**
Market integration	**1.02**	**0.38**	**0.01**	**1.99**	**1.15**	**0.08**	**1.05**	**0.44**	**0.02**
Intercept	−2.64	1.10	0.02	−2.04	2.50	0.42	−2.84	1.34	0.03
Observations	193			99			94		
Log-likelihood	−52.85			−11.54			−30.39		

Note: A firth logit model has been fitted. The dependent variable is climate change awareness. It equals 1 if a participant has heard about climate change and 0 if he or she has not heard about it. Bold numbers indicate statistical significance at the 10, % 5% and 1% level, respectively. P-values are rounded to two decimal places.

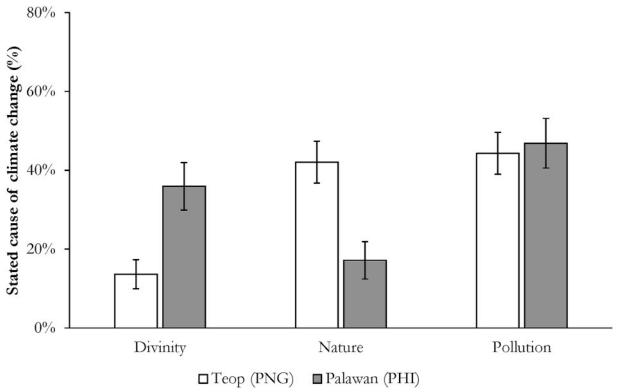

Fig. 3. Fraction of people indicating divinity, nature or pollution as the principal cause for climate change (with error bars).

Table 4A
Regression results (dependent variable: divinity).

	(1) Pooled			(2) Teop			(3) Palawan		
	coeff.	std. error	p-value	coeff.	std. error	p-value	coeff.	std. error	p-value
Society (0 = Palawan, 1 = Teop)	**−1.16**	**0.51**	**0.02**						
Male (0 = female, 1 = Male)	−0.72	0.44	0.10	−0.93	0.77	0.23	−0.36	0.59	0.55
More educated (0 = less educated, 1 = more educated)	−0.35	0.52	0.51	−0.78	0.73	0.28	0.19	0.82	0.81
Age	0.03	0.02	0.05	0.01	0.02	0.62	**0.05**	**0.02**	**0.02**
Wealth	0.02	0.15	0.91	0.20	0.25	0.42	−0.26	0.22	0.25
Muslim (0 = Non-Muslim, 1 = Muslim)	0.81	0.61	0.19				1.05	0.64	0.10
Vulnerability	**−0.65**	**0.25**	**0.01**	**−1.29**	**0.62**	**0.04**	−0.44	0.30	0.14
Information access	0.07	0.52	0.89	−0.43	0.72	0.55	1.24	0.90	0.17
Market integration	−0.32	0.36	0.38	−0.99	0.67	0.14	−0.09	0.49	0.85
Intercept	−0.74	1.13	0.51	−0.18	1.58	0.91	−2.58	1.56	0.10
Observations	152			88			64		
Log-likelihood	−50.43			−16.75			−22.59		

Note: A firth logit model has been fitted. The dependent variable is divinity. It equals 1 if a participant identified divinity as cause for climate change and 0 otherwise. The data is based on survey respondents who stated that they have heard about climate change. We only report regression results with non-missing values. Bold numbers indicate statistical significance at the 10, % 5% and 1% level, respectively. P-values are rounded to two decimal places.

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Table 4B
Regression results (dependent variable: nature).

	(1) Pooled			(2) Teop			(3) Palawan		
	coeff.	std. error	p-value	coeff.	std. error	p-value	coeff.	std. error	p-value
Society (0 = Palawan, 1 = Teop)	**1.52**	**0.50**	**0.00**						
Male (0 = female, 1 = Male)	0.00	0.37	0.99	0.11	0.46	0.81	−0.21	0.67	0.75
More educated (0 = less educated, 1 = more educated)	−0.09	0.45	0.83	−0.14	0.51	0.78	0.07	0.95	0.94
Age	−0.02	0.01	0.17	−0.03	0.02	0.13	−0.01	0.02	0.77
Wealth	**−0.24**	**0.14**	**0.08**	−0.27	0.17	0.13	−0.09	0.24	0.69
Muslim (0 = Non-Muslim, 1 = Muslim)	0.58	0.68	0.39				0.48	0.70	0.49
Vulnerability	0.16	0.19	0.39	0.12	0.23	0.60	0.22	0.34	0.52
Information access	−0.32	0.43	0.46	−0.17	0.51	0.74	−0.83	0.81	0.31
Market integration	0.05	0.28	0.85	0.07	0.33	0.83	0.00	0.51	1.00
Intercept	0.07	0.97	0.94	1.95	1.12	0.08	−0.54	1.57	0.73
Observations	152			88			64		
Log-likelihood	−70.03			−44.59			−18.27		

Note: A firth logit model has been fitted. The dependent variable is nature. It equals 1 if a participant identified nature as cause for climate change and 0 otherwise. The data is based on survey respondents who stated that they have heard about climate change. We only report regression results with non-missing values. Bold numbers indicate statistical significance at the 10, % 5% and 1% level, respectively. P-values are rounded to two decimal places.

Table 4C
Regression results (dependent variable: pollution).

	(1) Pooled			(2) Teop			(3) Palawan		
	coeff.	std. error	p-value	coeff.	std. error	p-value	coeff.	std. error	p-value
Society (0 = Palawan, 1 = Teop)	−0.39	0.39	0.32						
Male (0 = female, 1 = Male)	0.47	0.34	0.17	0.32	0.46	0.49	0.44	0.57	0.44
More educated (0 = less educated, 1 = more educated)	0.34	0.42	0.42	0.50	0.52	0.33	−0.29	0.76	0.70
Age	−0.01	0.01	0.47	0.02	0.02	0.24	**−0.05**	**0.02**	**0.03**
Wealth	0.19	0.12	0.13	0.14	0.17	0.40	0.25	0.2	0.21
Muslim (0 = Non-Muslim, 1 = Muslim)	**−1.03**	**0.61**	**0.09**				**−1.31**	**0.67**	**0.05**
Vulnerability	0.28	0.17	0.11	0.27	0.23	0.23	0.25	0.28	0.37
Information access	0.17	0.41	0.68	0.45	0.52	0.39	−0.17	0.79	0.83
Market integration	0.22	0.27	0.41	0.25	0.34	0.45	−0.01	0.46	0.98
Intercept	−1.3	0.95	0.17	−3.1	1.19	0.01	1.09	1.42	0.44
Observations	152			88			64		
Log-likelihood	−78.62			−43.40			−24.38		

Note: A firth logit model has been fitted. The dependent variable is pollution. It equals 1 if a participant identified pollution as cause for climate change and 0 otherwise. The data is based on survey respondents who stated that they have heard about climate change. We only report regression results with non-missing values. Bold numbers indicate statistical significance at the 10, % 5% and 1% level, respectively. P-values are rounded to two decimal places.

captures differences between the two societies. Positive signs of *Society* in Tables 4 A–C indicate that Teop people are more likely to believe that divinity, nature and pollution are causes of climate change than Palawan people do, while negative signs indicate the opposite.

Regression results confirm our findings from descriptive statistics. The *Society* coefficient in Table 4A is negative and statistically significant. This implies that Palawan people are more likely to believe that divinity causes climate change than Teop people do. The opposite is true for nature. The *Society* coefficient in Table 4B is positive and also statistically significant. This means that Teop people are more likely to believe that nature causes climate change than Palawan people do. As expected, for pollution as a cause of climate change, we find no significant difference between the two societies. The *Society* coefficient in Table 4C is statistically not significant.

Most of the socio-economic and demographic characteristics fail to significantly predict outcomes. The belief that nature is the cause for climate change cannot be explained by any of the variables (except of a weakly significant effect of wealth), neither on the aggregate nor on the society level (see Table 4B). Respondents that perceive themselves as more vulnerable, are significantly less likely to believe that climate change is the will of god (Table 4A). This effect holds for the pooled model and for the Teop subsample. For the Palawan subsample, the coefficient of age is positive and statistically significant. Thus, the probability to believe that divinity is causing climate change increases with age. With respect to pollution (Table 4C), non-Muslims and younger people in Palawan are more likely to believe that pollution causes climate change as compared to Muslims and older people.

Important in this context is that education and connectivity have an impact on awareness but do not significantly predict knowledge about the causes of climate change. Instead, more vulnerable people seem to be better informed about the causes than

Table 5
Perceived vulnerability.

Panel A (summary statistics)

	Pooled data	Teop (PNG)	Palawan (PHI)
Perceived vulnerability			
Shortage of rain	17,61%	14,14%	21,27%
Abundance of rain	33,68%	21,21%	46,80%
Crop diseases	47,67%	38,38%	57,45%
Sea-level change	13,47%	14,14%	12,77%
Observations	193	99	94

Panel B (Correlation matrix)

	Pooled data			Teop (PNG)			Palawan (PHI)		
	Divinity	Nature	Pollution	Divinity	Nature	Pollution	Divinity	Nature	Pollution
Shortage of rain	-0.13	-0.13	**0.23**	-0.17	**-0.18**	**0.30**	-0.14	-0.02	0.15
	(0.11)	(0.11)	**(0.00)**	(0.11)	**(0.09)**	**(0.00)**	(0.29)	(0.85)	(0.24)
Abundance of rain	-0.05	-0.02	0.07	-0.15	0.06	0.04	-0.09	0.00	0.09
	(0.54)	(0.77)	(0.43)	(0.18)	(0.56)	(0.73)	(0.47)	(0.99)	(0.49)
Crop diseases	**-0.14**	0.04	0.09	**-0.20**	0.09	0.05	-0.19	0.07	0.13
	(0.08)	(0.66)	(0.28)	**(0.07)**	(0.42)	(0.65)	(0.13)	(0.59)	(0.29)
Sea-level change	-0.13	**0.14**	-0.02	-0.17	0.13	-0.01	-0.05	0.11	-0.03
	(0.12)	**(0.09)**	(0.80)	(0.11)	(0.22)	(0.90)	(0.67)	(0.41)	(0.83)
Observations	152	152	152	88	88	88	64	64	64

Note: Pearsons's pairwaise correlation is applied. P-values are in brackets. Bold numbers indicate statistical significance at the 10%, 5% and 1% level, respectively. P-values are rounded to two decimal places. Panel B includes only respondents that have heard about climate change (152 out of 193 respondents).

others.

To understand how subjective vulnerability for different events is affecting local people's understanding of climate change, we explore the relationship of each vulnerability event (i.e., shortage of rain, abundance of rain, crop diseases, and sea-level change) and knowledge about climate change causes separately. Table 5 (Panel A) shows summary statistics of our perceived vulnerability measure.[10] In both societies, people feel most vulnerable to crop disease related events (Teop: 38%, Palawan: 57%), followed by abundance of rain (Teop: 21%, Palawan: 46%), shortage of rain (Teop: 14%, Palawan: 21%), and sea-level change (Teop: 14%, Palawan: 12%).

Table 5 (Panel B) shows the correlations between each vulnerability variable and the causes of climate change. The correlation analysis reveals some interesting patterns. The correlation coefficients of each vulnerability event are negative and of considerable size for divinity on the pooled level and across societies (though only borderline significant for crop diseases on the pooled level and in Teop). In contrast, the sizes and directions of correlation coefficients are more mixed for pollution and nature. More precisely, shortage of rain is positively and statistically significantly correlated with pollution (pooled and Teop) and negatively correlated with nature. The correlation coefficient of sea-level change is positive for nature but close to zero for divinity and pollution.[11] These results indicate a complex relationship between different types of experienced vulnerability events and knowledge of climate change causes.

5. Discussion

Both the awareness of climate change and the perception of its causes greatly influence public support of climate change policies in industrialized countries (Moser, 2010; Nisbet, 2009). In addition, both aspects have been identified to present potential barriers to adaptation, particularly in remote Pacific Islands (Betzold, 2015; Nunn et al., 2014). This paper provides specific empirical evidence for two small island societies. We substantiate previous findings by first determining the relative influence of socio-economic characteristics, connectivity and vulnerability on climate change awareness across the two societies before we analyze people's perception of its causes. Unlike earlier studies, which focused on qualitative findings, our study relies on a quantitative assessment.

In line with previous studies we find strong heterogeneity in climate change awareness across the two island societies. Respondents in Teop are much more aware of climate change than those in Palawan. Unlike earlier studies, the level of awareness is relatively high. The majority of people in both societies have heard about climate change. This can be explained by the higher level of

[10] Vulnerability is defined as relative vulnerability compared to others. The variable takes on the value 1 if perceived vulnerability in one of the categories is higher compared to others, and 0 otherwise. See section 3.1 for more details.

[11] We also correlated vulnerability variables with awareness. The correlation coefficients of vulnerability events and awareness is close to zero and statistically insignificant.

market integration and better access to information of respondents in our sample as compared to, for example, respondents living within the far periphery of Cook Islands, Fiji Islands, Kiribati or Vanuatu (Nunn et al., 2014). In some of these more remote island communities only half of the respondents or even less have heard about climate change (Mataki et al., 2007; Nunn et al., 2014; Lata and Nunn, 2012).

Although many people in our sample have heard about climate change, only about 40% of the respondents in both societies believe that climate change is caused by humans. Similarly, to the results depicted by Lata and Nunn (2012), a large part of Palawan people trace climate change back to a higher will, i.e. a divine will. A similarly large part of Teop people think that climate change is caused by nature. Thus, there is quite some heterogeneity in the understanding of the causes of climate change across the two societies suggesting that society-specific factors and values play a prominent role.

Local beliefs or religion may help to explain people's misunderstandings of climate change causes. As shown by other scientific publications, the belief that there is a higher divine or God who would not allow islanders' livelihoods to decline due to the impacts of climate change is used as reasoning to remain inactive towards climate change (Betzold, 2015; Mortreux and Barnett, 2009; Nunn et al., 2016a,b). This faith may also result in a disbelief that climate change is caused by humans. Our findings of Table 4C partly support this claim. The data shows that Muslims in Palawan are more likely to believe that pollution is not the cause of climate change compared to Non-Muslims (although the results are only weakly statistically significant).

Confirming the findings of Lee et al. (2015) we furthermore find that more educated islanders are more aware of climate change. Yet, somewhat unexpectedly, higher educational attainment or higher levels of connectivity, measured as market integration or information access, do not lead to a better understanding of its causes.

Local barriers seem to exist that hamper an effective knowledge transfer. Previous studies conclude that people living in island societies perceive climate change as something that is vague and distant. From a temporal perspective, climate change is a 'discounted future problem' (Mortreux and Barnett, 2009), an 'unlikely adversity in the future' (Mataki et al., 2006:19) and a 'low probability event' (Tompkins, 2005:144). Developmental challenges like poverty or food security (Nunn, 2013; Iati, 2008) are seemingly more pressing and require more immediate attention since surviving is at stake in this subsistence environment.

Finally, we also look at subjective vulnerability. Previous studies have focused on the physical aspects of vulnerability such as place and proximity to climate change risks (see e.g., Brody et al., 2008) or on objective indicators such as key socioeconomic variables and other types of capital that support people's livelihoods (Bahadur et al., 2015). Measuring subjective vulnerability addresses some factors that are neglected by physical and objective indicators such as cultural specifics and local people's own knowledge of their resilience. Addressing these factors are important when it comes to measuring people's perception of risk. We find that islanders who feel that they are more vulnerable to climate change related events than other community members do not believe that God is responsible for it. In particular, each of our subjective vulnerability measure (i.e., rain shortage, rain abundance, crop disease and sea-level change) is negatively correlated with the belief that god's will is causing climate change. On the others side, only one measure of subjective vulnerability, namely shortage of rain, is clearly positively correlated with the belief that pollution is causing climate change. Thus, different experiences of subjective vulnerability that are directly linked to basic livelihood threats seem to play an important role in understanding the causes of climate change.

Overall, these findings suggest that connectivity and information access increase awareness but only local people's sense of vulnerability is affecting knowledge about the causes of climate change. Future research should expand the analysis of vulnerability and resilience beyond the metrics of exposure to risk and unexpected contingencies. A promising research direction is to analyze the relationship of connectivity (via market integration and communication access) and the sense of vulnerability that local people perceive which in turn could be linked to global discussions on climate change. In particular, market integration and communications access may increase the frequency of climate change related news without actually raising local people's understanding of the causes of climate change. It is up to future research to explore the mechanisms behind this discrepancy. In this way one could investigate how global discussion affect awareness and understanding of climate change causes on the local scale.

As other survey results, our findings have some potential shortcomings with respect to the explanatory power and the research design. First, our results are based on a small and non-representative subset of the island population. Thus, we cannot generalize our results to the broader population of Palawan or Bougainville. Running statistical tests and regressions with small sample size also comes with the risk of low statistical power. While we control for any potential biases by using advanced econometric techniques, the results and effect sizes must be interpreted cautiously. Secondly, as many other cross-cultural studies, our study has also limitations in the research design. We argue that the cultural background has an important effect on local people's perception of climate change and factors that influence their understanding. The result may truly be driven by cultural differences in the two societies, but there could be some other unseen explanations. To truly isolate the factor of culture, the ideal study would randomly assign different cultural specifics to otherwise identical societies. Such a study is, however, not feasible. To get as close as possible to this ideal survey, we followed to the second-best approach and conduct a cross-cultural study in island societies that are very similar along important dimension but have opposite cultures.

A further challenge with our cross-cultural research design is the translation of climate change and what is understood to be its cause or consequence. It is important to note that meanings of the term can vary within and between societies. As demonstrated by Rudiak-Gould (2012) translating the world "climate" into Marshallese implies cosmos, nature, and culture as well as weather and climate. This author suggests that similar processes are likely to be relevant in other parts of the world, particularly given that for many societies ideas of culture and nature are not conceptually distinct. Other studies have also shown that the linguistic framing of climate change can influence how concern-worthy the threat appears: for instance, George Lakoff and George Monbiot have suggested (Butler, 2006; Monbiot, 2009), and Whitmarsh (2009) has empirically confirmed, that 'climate change' sounds neutral to publics even though science communicators intend it to be alarming. Although we notice the importance of this literature, the

potential for cross-cultural variability in notions of climate change should nevertheless be borne in mind as a limitation in the case of cross-cultural comparisons of climate change perceptions. It is left to future research to consider the different meanings and notions of the term climate change when conducting cross-cultural studies.

6. Conclusion

The motivation for this research comes from the increasing attention on public perception of climate change in island communities, an area that is largely under researched. While a small number of studies exist, profound empirical research including statistical analyses is still missing. Quantitative methods are valuable tools to complement qualitative work with respect to reliability, accuracy, and creditability of findings. In the area under investigation, quantitative cross-country studies from remote areas enable identifying both common and local factors that influence public awareness and understanding of climate change.

Previous studies concluded that local island populations and their leaders, i.e. decision-makers on local and national levels, show insufficient knowledge on climate change and its impacts. Comparing two unique island societies - the Teop in Bougainville (Papua New Guinea) and the Palawan (Philippines) - we show that awareness of climate change is relatively high and that factors such as education, market integration and access to information increase awareness across societies. The same factors do not seem to affect people's understanding of the causes of climate change. In addition, misperception of climate change causes is quite heterogeneous suggesting that local factors such as beliefs, values, and other short-term pressing problems (poverty and food security) limit understanding.

The results of the present paper provide valuable insights for the design of climate policies in Bougainville and Palawan. On the national level, top-down approaches aiming to increase climate change awareness may be appropriate when channeled through common factors such as education or improved access to information and markets. In contrast, bottom-up approaches are the key for efficient climate change policies on the local level in Bougainville and Palawan. Local bottom-up approaches that consider the cultural background of a society are necessary to increase understanding of the causes of climate change since it is clearly subject to local beliefs, values and norms. Hence, providing local decision-makers such as village chiefs and/or religious leaders with information about causes, associated risks and dangers of climate change is crucial in order to increase public support of climate change policies and successfully implement locally driven adaptation measures. It is left to future comparative studies to explore common factors that influence climate change awareness within and across small island societies on a broader scale and in more detail. In doing so, findings can be generalized and used to design climate change policies more effectively.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.envdev.2019.04.002.

References

Aalbersberg, B., 2005. Village by village: recovering Fiji's coastal fisheries, turning natural assets into wealth: case studies. In: World Resources 2005: the Wealth of the Poor: Managing Ecosystems to Fight Poverty, pp. 144–151.
Alcantara, A.N., 1994. Gender roles, fertility, and the status of married Filipino men and women. Philippine Socio. Rev. 42 (1/4), 94–109.
Aswani, S., Vaccaro, I., Abernethy, K., Albert, S., de Pablo, J.F.L., 2015. Can perceptions of environmental and climate change in island communities assist in adaptation planning locally? Environ. Manag. 56 (6), 1487–1501.
Bahadur, A., Wilkinson, E., Tanner, T., 2015. Resilience Frameworks: a Review. Overseas Development Institute, London.
Baptiste, A.K., 2018. Climate change knowledge, concerns, and behaviors among Caribbean Fishers. J. Environ. Soc. Sci. 8 (1), 51–62.
Barnett, J., 2011. Dangerous climate change in the Pacific Islands: food production and food security. Reg. Environ. Change 11, 229–237.
Barnett, J., Campbell, J., 2010. Climate change and small island states: power, knowledge, and the South Pacific. Earthscan.
Bayliss-Smith, T., Bedford, R., Brookfield, H., 2006. Islands, Islanders and the World: the Colonial and Post-colonial Experience of Eastern Fiji. Cambridge University Press.
Bernhard, H., Fischbacher, U., Fehr, E., 2006. Parochial altruism in humans. Nature 44 (7105), 912.
Bertram, G., 2004. On the convergence of small island economies with their metropolitan patrons. World Dev. 32 (2), 343–364.
Betzold, C., 2015. Adapting to climate change in small island developing states. Clim. Change 133, 481–489.
Beyerl, K., Mieg, H.A., Weber, E., 2018. Comparing perceived effects of climate-related environmental change and adaptation strategies for the Pacific small island states of Tuvalu, Samoa, and Tonga. Island Stud. J. 13 (1).
Borick, C.P., Rabe, B.G., 2010. A reason to believe: examining the factors that determine individual views on global warming. Soc. Sci. Q. 91 (3), 777–800.
Briguglio, L., 1995. Small island developing states and their economic vulnerabilities. World Dev. 23 (9), 1615–1632.
Brody, S.D., Zahran, S., Vedlitz, A., Grover, H., 2008. Examining the relationship between physical vulnerability and public perceptions of global climate change in the United States. Environ. Behav. 40 (1), 72–95.
Brulle, R.J., Carmichael, J., Jenkins, J.C., 2012. Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the US, 2002–2010. Clim. Change 114 (2), 169–188.
Bunce, M., Mee, L., Rodwell, L.D., Gibb, R., 2009. Collapse and recovery in a remote small island—a tale of adaptive cycles or downward spirals? Glob. Environ. Chang. 19 (2), 213–226.
Butler, K., 2006. Winning Words: George Lakoff Says Environmentalists Need to Watch Their Language. Sierra Magazine July/August. Available. http://www.katybutler.com/publications/sierramag/index_files/latimes_daddy.htm, Accessed date: 26 September 2018.
Connell, J., 2013. Islands at Risk?: Environments, Economies and Contemporary Change. Edward Elgar Publishing.

Coveney, J., 2015. FIRTHLOGIT: Stata Module to Calculate Bias Reduction in Logistic Regression. Software component provided by Boston College Department of Economics in its series Statistical Software Components with number S456948.
Dumaru, P., 2010. Community-based adaptation: enhancing community adaptive capacity in Druadrua Island, Fiji. Wiley Interdiscipl. Rev.: Clim. Change 1 (5), 751–763.
Firth, D., 1993. Bias reduction of maximum likelihood estimates. Biometrika 80 (1), 27–38.
Grimalda, G., Pondorfer, A., Tracer, D.P., 2016. Social image concerns promote cooperation more than altruistic punishment. Nat. Commun. 7, 12288.
Hay, J., Mimura, N., 2006. Supporting climate change vulnerability and adaptation assessments in the Asia-Pacific region: an example of sustainability science. Sustain. Sci. 1 (1), 23–35.
Hay, J.E., Mimura, N., Campbell, J., Fifita, S., Koshy, K., McLean, R.F., de Wet, N., 2003. Climate Variability and Change and Sea-Level Rise in the Pacific Islands Region: a Resource Book for Policy and Decision Makers, Educators and Other Stakeholders. South Pacific Regional Environment Programme (SPREP).
Heinze, G., Schemper, M., 2002. A solution to the problem of separation in logistic regression. Stat. Med. 21 (16), 2409–2419.
Henrich, J., Ensminger, J., McElreath, R., Barr, A., Barrett, C., Bolyanatz, A., et al., 2010. Markets, religion, community size, and the evolution of fairness and punishment. Science 327 (5972), 1480–1484.
Hine, D.W., Phillips, W.J., Cooksey, R., Reser, J.P., Nunn, P., Marks, A.D.G., Loi, N.M., Watt, S.E., 2016. Preaching to different choirs: how to motivate dismissive, uncommitted, and alarmed audiences to adapt to climate change? Glob. Environ. Chang. Human Pol. Dimens. 36, 1–11.
Iati, I., 2008. The potential of civil society in climate change adaptation strategies. Polit. Sci. 60 (1), 19–30.
IPCC, 2001. Climate change 2001: full report. [Smit, B. & Pilifosova, O. and lead authors, Burton, I., Challenger, B., Huq, S., Klein, R.J.T., Yohe, G.] In: Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Chapter 18. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 879–912.
Janssen, M.A., Bodin, Ö., Anderies, J.M., Elmqvist, T., Ernstson, H., McAllister, R.R., et al., 2006a. Toward a network perspective of the study of resilience in social-ecological systems. Ecol. Soc. 11 (1).
Janssen, M.A., Schoon, M.L., Ke, W., Börner, K., 2006b. Scholarly networks on resilience, vulnerability and adaptation within the human dimensions of global environmental change. Glob. Environ. Chang. 16 (3), 240–252.
Janssen, M.A., Anderies, J.M., Ostrom, E., 2007. Robustness of social-ecological systems to spatial and temporal variability. Soc. Nat. Resour. 20 (4), 307–322.
Kelman, I., 2010. Hearing local voices from small island developing states for climate change. Local Environ. 15 (7), 605–619.
Kibue, G.W., Liu, X., Zheng, J., Pan, G., Li, L., Han, X., 2016. Farmers' perceptions of climate variability and factors influencing adaptation: evidence from Anhui and Jiangsu, China. Environ. Manag. 57 (5), 976–986.
Kuruppu, N., Liverman, D., 2011. Mental preparation for climate adaptation: the role of cognition and culture in enhancing adaptive capacity of water management in Kiribati. Glob. Environ. Chang. 21 (2), 657–669.
Kuruppu, N., Willie, R., 2015. Barriers to reducing climate enhanced disaster risks in least developed country-small islands through anticipatory adaptation. Weather Clim. Extrem. 7, 72–83.
Kvaløy, B., Finseraas, H., Listhaug, O., 2012. The publics' concern for global warming: a cross-national study of 47 countries. J. Peace Res. 49 (1), 11–22.
Lata, S., Nunn, P., 2012. Misperceptions of climate-change risk as barriers to climate-change adaptation: a case study from the Rewa Delta, Fiji. Clim. Change 110 (1–2), 169–186.
Lebel, L., 2013. Local knowledge and adaptation to climate change in natural resource-based societies of the Asia-Pacific. Mitig. Adapt. Strategies Glob. Change 18 (7), 1057–1076.
Lee, T.M., Markowitz, E.M., Howe, P.D., Ko, C.Y., Leiserowitz, A.A., 2015. Predictors of public climate change awareness and risk perception around the world. Nat. Clim. Change 5 (11), 1014.
Leiserowitz, A., 2006. Climate change risk perception and policy preferences: the role of affect, imagery, and values. Clim. Change 77 (1–2), 45–72.
Limsa, M., 2014. Personal Email Communication with Mercedes Limsa, Director of the Indigenous NGO Natripal in Palawan.
Lindell, M.K., Hwang, S.N., 2008. Households' perceived personal risk and responses in a multihazard environment. Risk Anal. 28 (2), 539–556.
Lorenzoni, I., Pidgeon, N.F., 2006. Public views on climate change: european and USA perspectives. Clim. Change 77 (1–2), 73–95.
Lorenzoni, I., Nicholson-Cole, S., Whitmarsh, L., 2007. Barriers perceived to engaging with climate change among the UK public and their policy implications. Glob. Environ. Chang. 17 (3–4), 445–459.
Marshall, N.A., Park, S., Howden, S.M., Dowd, A.B., Jakku, E.S., 2013. Climate change awareness is associated with enhanced adaptive capacity. Agric. Syst. 117, 30–34.
Mataki, M., Koshy, K., Nair, V., 2006. Implementing Climate Change Adaptation in the Pacific Islands: Adapting to Present Climate Variability and Extreme Weather Events in Navua (Fiji). Assessments of Impacts and Adaptations to Climate Change (AIACC), Florida, USA.
Mataki, M., Koshy, K., Nair, V., 2007. Top-down, bottom-up: mainstreaming adaptation in Pacific Island townships. In: Leary, N., Adejuwon, J., Barros, V., Burton, I., Kulkarni, J., Lasco, R. (Eds.), Climate Change and Adaptation. Earthscan, London, pp. 264–278.
McMillen, H.L., Ticktin, T., Friedlander, A., Jupiter, S.D., Thaman, R., Campbell, J., et al., 2014. Small islands, valuable insights: systems of customary resource use and resilience to climate change in the Pacific. Ecol. Soc. 19 (4).
Monbiot, G., 2009. Time to Change 'climate Change'. Guardian.co.uk 12 March. Available at: www.guardian.co.uk/commentisfree/2009/mar/12/climate-change-copenhagen-monbiot (accessed 01.12.2010).
Mortreux, C., Barnett, J., 2009. Climate change, migration and adaptation in Funafuti, Tuvalu. Glob. Environ. Chang. 19 (1), 105–112.
Moser, S.C., 2010. Communicating climate change: history, challenges, process and future directions. Wiley Interdiscipl. Rev.: Clim. Change 1 (1), 31–53.
Newton, A., Weichselgartner, J., 2014. Hotspots of coastal vulnerability: a DPSIR analysis to find societal pathways and responses. Estuar. Coast Shelf Sci. 140, 123–133.
Nisbet, M.C., 2009. Communicating climate change: why frames matter for public engagement. Environment 51 (2), 12–23.
Nunn, P.D., 2009. Responding to the challenges of climate change in the Pacific Islands: management and technological imperatives. Clim. Res. 40 (2/3), 211–231.
Nunn, P.D., 2013. The end of the Pacific? Effects of sea level rise on Pacific Island livelihoods. Singapore J. Trop. Geogr. 34, 143–171.
Nunn, P., Mimura, N., 2007. Promoting sustainability on vulnerable island coasts: a case study smaller Pacific Islands. In: Managing Coastal Vulnerability. Elsevier Science Ltd., pp. 195–221.
Nunn, P.D., Aalbersberg, W., Lata, S., Gwilliam, M., 2014. Beyond the core: community governance for climate-change adaptation in peripheral parts of Pacific Island Countries. Reg. Environ. Change 14 (1), 221–235.
Nunn, P.D., Mulgrew, K., Scott-Parker, B., Hine, D.W., Marks, A.D.G., Mahar, D., Maebuta, J., 2016a. Spirituality and attitudes towards Nature in the Pacific Islands: insights for enabling climate-change adaptation. Clim. Change 136, 477–493.
Nunn, P.D., Mulgrew, K., Scott-Parker, B., Hine, D.W., Marks, A.D., Mahar, D., Maebuta, J., 2016b. Spirituality and attitudes towards Nature in the Pacific Islands: insights for enabling climate-change adaptation. Clim. Change 136 (3–4), 477–493.
Nurse, L.A., McLean, R.F., Agard, J., Briguglio, L.P., Duvat-Magnan, V., Pelesikoti, N., Tompkins, E., Webb, A., 2014. Small islands. In: Barros, V.R., Field, C.B., Dokken, D.J., Mastrandrea, M.D., Mach, K.J., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.L. (Eds.), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1613–1654.
Peacock, W.G., Brody, S.D., Highfield, W., 2005. Hurricane risk perceptions among Florida's single family homeowners. Landsc. Urban Plann. 73 (2–3), 120–135.
Pidgeon, N., 2012. Public understanding of, and attitudes to, climate change: UK and international perspectives and policy. Clim. Policy 12 (Suppl. 01), S85–S106.
Pondorfer, A., Rehdanz, K., 2018. Eliciting preferences for public goods in nonmonetized communities: accounting for preference uncertainty. Land Econ. 94 (1), 73–86.
Pondorfer, A., Barsbai, T., Schmidt, U., 2016. Gender differences in stereotypes of risk preferences: experimental evidence from a matrilineal and a patrilineal society.

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Manag. Sci. 63 (10), 3268–3284.
Rawlins, S.C., Chen, A., Rawlins, J.M., Chadee, D.D., Legall, G., 2007. A knowledge, attitude and practices study of the issues of climate change/variability impacts and public health in Trinidad and Tobago, and St Kitts and Nevis. W. Indian Med. J. 56 (2), 115–121.
Regan, A.J., Griffin, H.M., 2005. Bougainville: before the Conflict. Pandanus Books, Canberra.
Rudiak-Gould, P., 2012. Promiscuous corroboration and climate change translation: a case study from the Marshall Islands. Glob. Environ. Chang. 22 (1), 46–54.
Scott-Parker, B., Kumar, R., 2018. Fijian adolescents' understanding and evaluation of climate change: implications for enabling effective future adaptation. Asia Pac. Viewp. 59, 47–59.
Scott-Parker, B., Nunn, P.D., Mulgrew, K., Hine, D., Marks, A., Mahar, D., Tiko, L., 2017. Pacific Islanders' understanding of climate change: where do they source information and to what extent do they trust it? Reg. Environ. Change 17, 1005–1015.
Tompkins, E.L., 2005. Planning for climate change in small islands: insights from national hurricane preparedness in the Cayman Islands. Glob. Environ. Chang. 15 (2), 139–149.
Tracer, D.P., Mueller, I., Morse, J., 2004. Cruel to Be Kind: Effects of Sanctions and Third-Party Enforcers on Generosity in Papua New Guinea.
Vignola, R., Koellner, T., Scholz, R.W., McDaniels, T.L., 2010. Decision-making by farmers regarding ecosystem services: factors affecting soil conservation efforts in Costa Rica. Land Use Pol. 27 (4), 1132–1142.
Weber, E.U., Stern, P.C., 2011. Public understanding of climate change in the United States. Am. Psychol. 66 (4), 315.
Whitmarsh, L., 2009. What's in a name?. Commonalities and differences in public understanding of “climate change” and “global warming”. Publ. Understand. Sci. 18 (4), 401–420.
Whitmarsh, L., 2011. Scepticism and uncertainty about climate change: dimensions, determinants and change over time. Glob. Environ. Chang. 21 (2), 690–700.
Wolf, J., Moser, S.C., 2011. Individual understandings, perceptions, and engagement with climate change: insights from in-depth studies across the world. Wiley Interdiscipl. Rev.: Clim. Change 2 (4), 547–569.